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OBSERVATIONS ON MASS SPAWNING OF SCLERACTINIAN CORALS IN GUADELOUPE

BY

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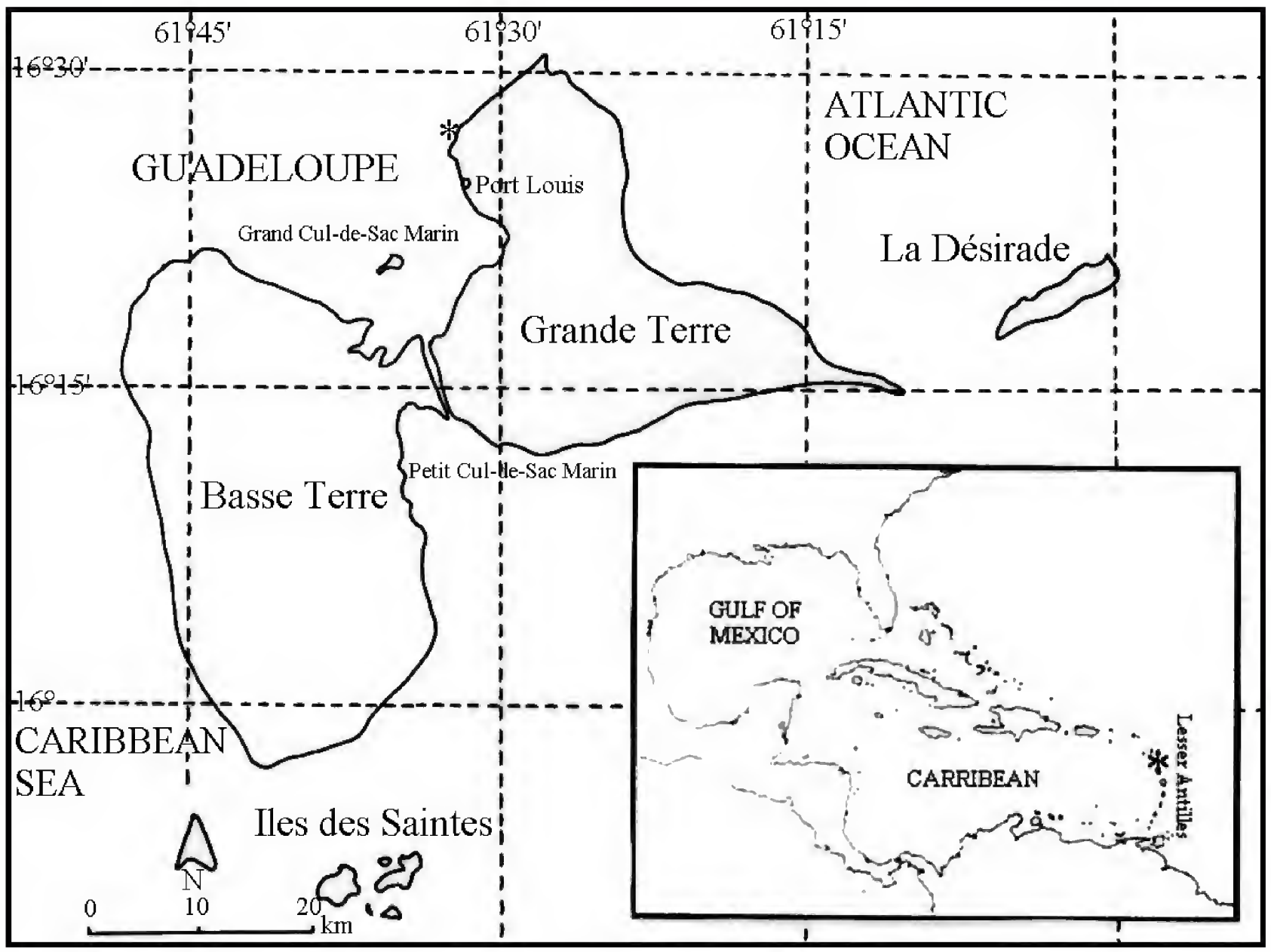

Figure 1. Location map of Guadeloupe showing location of the spawning observations (star).

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ABSTRACT

This study aimed to document coral spawning on a fringing reef in Guadeloupe (Lesser Antilles). In situ observations were made between 21:30 and 23:00 on days 6, 7 and 8 following the full moon of August 2008. We were unable to observe any sign of reproductive activity 6 days after the full moon. Colonies of the massive star coral *Montastrea faveolata* were noticed to release bundles of gametes 7 days after the full moon. Multi-species synchronous spawning of corals was observed 8 days after the full moon of August. A total of three species (*Montastrea faveolata*, *Montastrea cavernosa* and *Diploria strigosa*) broadcast spawned. Moreover, the same night, we documented the presence of zygotes near the tips of the tentacles of *Eusmilia fastigiata* indicating that this species is ready to spawn and the swarming of a large number of polychaetous annelids including syllid polychaetes in the genus *Odontosyllis* which were observed at the surface water producing brillant displays of green bioluminescence during mating swarms.

INTRODUCTION

Mass-spawning activities of scleractinian corals, i.e. the synchronous release of gametes by colonies of more than one broadcast-spawning coral species (Willis et al., 1985), have received much public and scientific attention since the extent of this phenomenon became known (Harrison et al., 1984, Babcock et al., 1986). In the Caribbean region, multispecies mass spawning has been observed at several localities (Wyers et al., 1991; Gittings et al.,1992; van Veghel, 1993 ; Steiner, 1995; de Graaf et al., 1999; Sánchez et al., 1999; Bastidias et al., 2005). However, there are relatively few studies that document these events by direct observations of several species at different geographical locations. In fact, many of the species-spawning periods have been inferred from the presence or absence of gonads in histological studies (Wyers, 1985; Szmant, 1991 ; Acosta and Zea, 1997; Villinski, 2003).

Guadeloupe is lined with approximately 250 km² of reef which made one of the most important constituent of the Lesser Antilles (Spalding, 2004). However, the spawning behavior of reef invertebrates and especially scleractinian corals on Guadeloupe's reef has not been previously reported. Here we reported detailed observations on the timing of spawning for scleractinian corals following the full moons of August 2008.

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METHODS

Guadeloupe (Fig. 1) is located in the Lesser Antilles chain of the Caribbean and is composed of two main islands. The smaller, latter island of Guadeloupe proper is incongruously named Grande Terre (Big Land), while the larger mountainous volcanic island is equally strangely named Basse Terre (Low Land). These two are only separated by a narrow channel, the Rivière Salée, lined by dense mangroves and crossed by two bridges. The great bay, known as the Grand Cul-de-Sac Marin is strictly protected.

In situ observations of scleractinian corals spawning using SCUBA were made at the Les Arches site (The Archs) (16°27′529″ N, 61°32′021″ W) located near the town of Port Louis (approximately 5 kms north from Port Louis) on the western coast of Grande Terre (Fig. 1). This site was selected because it is the site in the region of Port Louis which has the highest rate of coral cover and the highest biodiversity of scleractinian corals (personal observations). It is part of a fringing-reef complex which drops in a steep slope to a sandy bottom at 20 m approximately. A section of Les Arches, 100 m long and 50 m wide parallel to the shore and ranging from 6 - 17 m in depth, was selected for this study. In this section, colonies were observed between about 21.30 and 23.00 on days 6, 7 and 8 following the full moons of August (16rd) and September (15rd). Our timing of monitoring was based on previous records of coral spawning in the Caribbean. Underwater photographs were also taken to detail the spawning behavior.

RESULTS

We were unable to observe any reproduction of scleractinian coral 6 days after the full moon of August. We documented the release of egg sperm bundles from colonies of the massive star coral *Montastrea faveolata* (Ellis and Solander, 1786, Figs. 2 and 3), the dominant scleractinian on the reef, 7 days after the full moon of August between 22:05 and 22:40. All colonies observed were in water depths of between 5 to 16 m. At approximately the same time the swarming of polychaetous annelids was noted (Fig. 2).

Figure 2. Mass spawning of the scleractinian coral *Montastrea faveolata* (Wednesday 23 August 2008, 22:28). Remark also the concomitant swarming of polychaetous annelids (A. Goyeau).

Figure 3. *Montastrea faveolata* colony releasing egg sperm bundles at night (Wednesday 23 August 2008, 22:08) (A. Goyeau).

Figure 4. Mass spawning of the scleractinian coral *Diploria strigosa* (Thursday 24 August 2008, 22:15) (A. Goyeau).

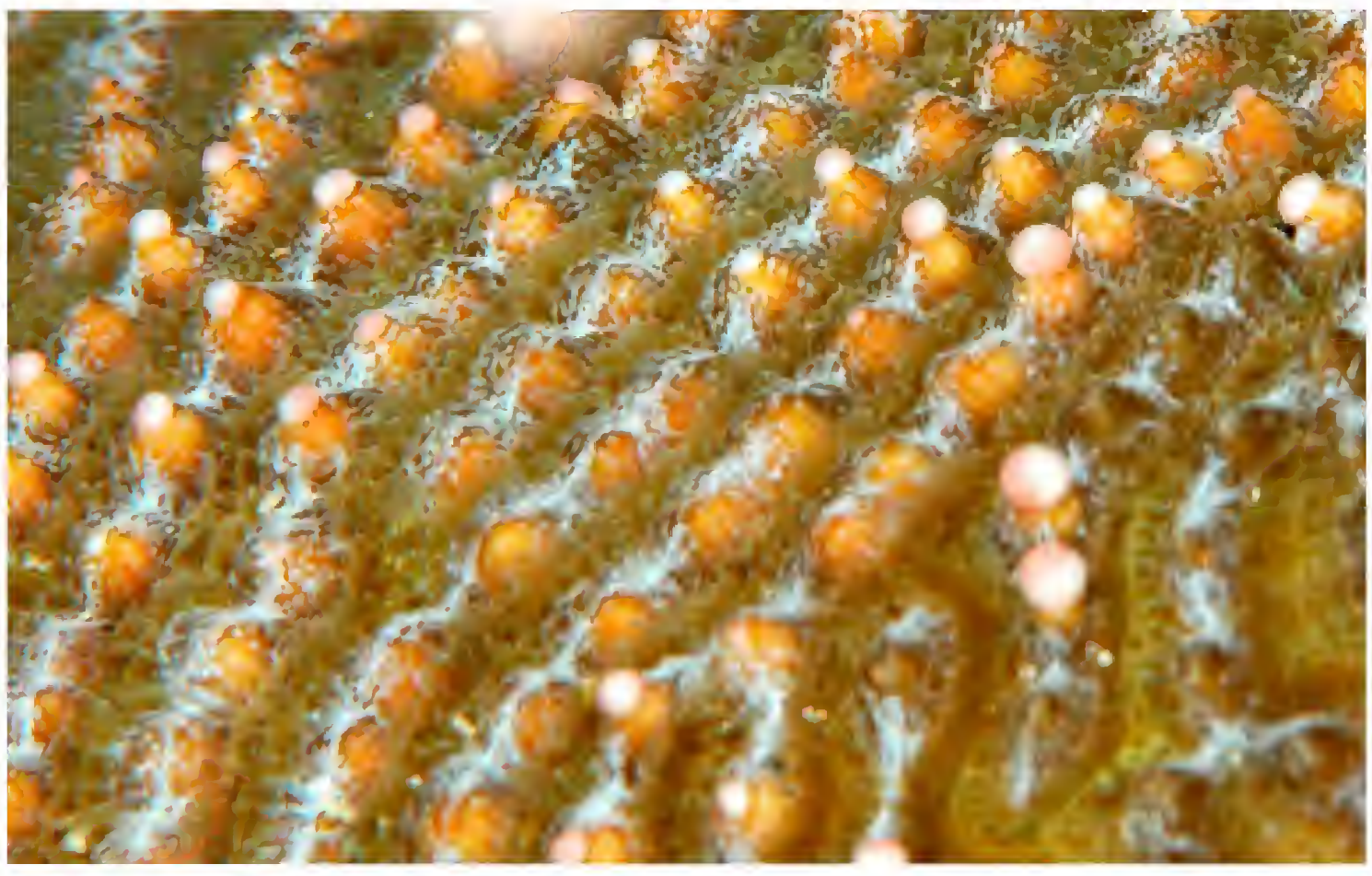

Figure 5. *Diploria strigosa* colony releasing egg sperm bundles at night (Thursday 24 August 2008, 22:16) (A. Goyeau).

On the 8th night after full moon of August we observed synchronous multispecific coral spawning. At 22:15 we noted the release of sperm from only one male colony of the large star coral *Montastrea cavernosa* (Linnaeus, 1766) at a depth of 12 m. We also observed copious spawning of colonies of the brain coral *Diploria strigosa* (Dana, 1848) (Fig. 4 and 5) and of the massive star coral *Montastrea faveolata* in water depths of between 5 to 16 m. Spawning started at 22:00 and ended at 22:35 for *Diploria strigosa* and started at 22:05 and ended at 22:35 for *Montastrea faveolata*. Moreover, zygotes were visible at the tip of the transparent tentacles of a single colony of *Eusmilia fastigiata* (Pallas, 1766) (Fig. 6). The zygotes were first noticed at 22:15 and were still visible at 22:50. According to the observations made by de Graaf et al., (1999), reproductive mode of *Eusmilia fastigiata* resembles brooding, however, unlike other brooders, *E. fastigiata* did not release well-developped planulae but zygotes in early developmental stages. Futhermore, the polychaete *Hermodice carunculata* (Pallas, 1766) was commonly seen preying on corals. The same night we observed the swarming of a large number of polychaetous annelids including syllid polychaetes in the genus *Odontosyllis* (Claparède, 1863) which were observed at the surface water producing brillant displays of green bioluminescence during mating swarms between 21:30 and 21:50.

Figure 6. *Eusmilia fastigiata* with zygotes visible in the tentacles (Thursday 24 August 2008, 22:24) (A. Goyeau).

We were unable to observe any reproduction of scleractinian coral 6 and 8 days after the full moon of September. We noticed the release of egg/sperm bundles from colonies of *Montastrea faveolata* 7 days after the full moon of September between 21:30 and 22:00, but the September spawning event was less important in the number of colonies involved than the spawning event of August.

In 2009, we again observed the spawning of corals approximately one week after the full moon of August (6rd) and September (4rd), confirming our previous observations. We documented the release of egg sperm bundles from colonies of *Montastrea faveolata* 6 days after the full moon of August between 22.15 and 22.40.
On the 7th night after full moon of August we noticed spawning of colonies of *Diploria strigosa* and *Montastrea faveolata.* Spawning started at 22.05 and ended at 22.35 for *Diploria strigosa* and started at 22.05 and ended at 22.40 for *Montastrea faveolata*.
We were unable to observe any reproduction of scleractinian coral 8 days after the full moon of August and 6 and 8 days after the full moon of September. We noticed copious spawning of colonies of *Montastrea faveolata* 7 days after the full moon of September between 21.50 and 22.25. Even colonies of *Montastrea faveolata* affected by yellow blotch syndrome were able to spawn in September (Fig. 7). Contrary to 2008, the September spawning event was more important than the spawning event of August.

Figure. 7. Spawning of *Montastrea faveolata* with yellow blotch syndrome (Friday, 11 September 2009, 22.20) (A. Goyeau).

DISCUSSION

This study shows that three common Caribbean faviid species (*Montastrea faveolata*, *M. cavernosa* and *Diploria strigosa*) spawn in the night around one week after the full moon of August and/or September in Guadeloupe. Spawning occurs during the warmest season when water temperature reach 29°C. *M. faveolata* is an important reef-building species found throughout the Caribbean. It is a member of the *M. annularis* species complex and has been separated from *M. annularis* (Ellis and Solander, 1786) and *M. franksi* (Gregory, 1895) as valid by Wiel and Knowlton, (1994). All three species

are simultaneous hermaphrodites broadcast spawners. Each polyp within the colony produce a single gamete bundle containing both sperm and eggs (Levitan et al., 2004). During the spawning event, which lasts less than an hour (Szmant et al., 1997; Sánchez et al., 1999), these gamete bundles are extruded from polyp (Fig. 2) and float to the water surface where they burst, releasing their contents for fertilization. *Diploria strigosa* is also hermaphroditic broadcaster with male and female gametes occurring in separate but adjacent regions of the same mesentery. Contrary to the other two species observed spawning in our study site, *M. cavernosa* is gonochoric broadcaster.

The spawning patterns of *M. faveolata*, *M. cavernosa* and *D. strigosa* in Guadeloupe are very similar to previous reports for most localities in the Caribbean, i.e. colonies typically spawn once a year during the annual mass spawning event between 7 and 8 days after a full moon in late summer (typically in August or September) (Szmant, 1986, 1991; Soong, 1991; Wyers et al., 1991; Gittings et al., 1992; van Veghel, 1993, 1994; Steiner, 1995; Knowlton et al., 1997; Szmant et al., 1997; Acosta and Zea, 1997; Hagman et al., 1998; de Graaf et al., 1999; Sánchez et al.,1999; Villinski, 2003; Beaver et al., 2004; Bastidias et al., 2005). It seems that spawning is linked with seawater temperature, since all events take place during the warmest local period.

We also reported the presence of zygotes near the tip of the tentacles of a single colony of *E. fastigiata* indicating that this species is ready to spawn 8 nights after the full moon of August. According to the observations made by de Graaf et al. (1999), reproductive mode of *E. fastigiata* resembles brooding, however, unlike other brooders, *E. fastigiata* did not release well-developped planulae but zygotes in early developmental stages. Our observations with those of Bastidias et al. (1999), who also noticed the presence of zygotes at the tip of the tentacles in two colonies of *E. fastigiata* 7 nights after the full moon of August 1999. These zygotes were released the 8th night on a Venezuelan inshore reef. In September, these same two colonies again showed zygotes; first noticed at 20:15 on the 7th and still visible at 22:15 on the 8th night after full moon, their last day of observation. However, there is a geographic variation in the timing of zygotes release. Thus, de Graaf et al. (1999), observed the release of zygotes from the tip of the tentacles of a colony for several hours each night over a period of at least four nights after the full moon of September and October 1996 on the reefs of Bonaire. A similar pattern of gamete release was observed in 1997. After the full moon of 16 October 1997 zygotes were released at night 5, 6 and 7 between 19:45 and 22:25.

Our observation of swarming by large number of marine polychaetes of the genus *Odontosyllis* 8 days after the full moon of August are consistent with other studies from the Caribbean indicating that syllid polychaetes in the genus *Odontosyllis* appear at the surface of the water shortly after sunset and luminesce and spawn for short periods (Market et al., 1961, Erdman, 1965, Fisher and Fisher, 1995, Gaston and Hall, 2000). Bioluminescence displays occur with lunar periodicity during reproductive swarming and, in the case of *Odontosyllis luminosa,* reproduction peaks during summer in Belize (Gaston and Hall, 2000). In Venezuela, bioluminescent polychaetes of the genus *Odontosyllis* were observed spawning at the water surface in August and at lower densities in September on an inshore reef but not on an offshore reef (Bastidias et al., 2005).

In conclusion, this report represents the first documented observation of multispecific, synchronous mass spawning of scleractinian corals in Guadeloupe.

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